用户使用说明书

Altus强震记录仪

GPS时间服务系统

User's Guide 使用手册

GPS Timing Systems

for Altus Recorder Systems

Altus 记录仪
GPS 时间服务系统

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Contacting Kinemetrics

Contact Kinemetrics for technical support or further product information at one of the following addresses.

Kinemetrics, Inc., 222 Vista Avenue, Pasadena, CA 91107 USA
Telephone: 626.795.2220   Fax: 626.795.0868

Email: services@kmi.com

Kinemetrics SA, Le Tresi 3, 1028 Preverenges, Switzerland
Telephone: 21.803.2829   Fax: 21.803.2895

Website: www.kinemetrics.com

公司联系方式

采用如下方式可与本公司取得联系，以取得技术支持或获取更多产品信息。

美国公司地址：**Kinemetrics, Inc., 222 Vista Avenue, Pasadena,CA 91107 USA**

电话：626 795 2220   传真：626 795 0868   E-mail: Services @ Kmi .Com

网址：www. kinemetrics.com

瑞士公司地址：Kinemetrics SA, Le Tresi 3, 1028 Preverenges, Switzerland

电话：21 803 2829   传真：21 803 2895

网址：www. kinemetrics.com

Safety 安全须知

Symbols & Terms

The following terms might appear in this manual:

Note: A statement identified as a note offers specific information about the instruction or choice at hand.

Please pay attention to any cautions and warnings as they appear.

Caution: A caution statement identifies conditions or actions that could result in damage to the equipment, to the software, to the data, or other property.

WARNING! A warning statement identifies conditions or practices that could result in bodily injury or loss of life.

专用符号条目

以下专用条目可能会在本手册中出现：
注解：每一条注解是为了提供在该情况下有关指导或手工选择的专门信息。
当 " **警告** " 或 " **注意** " 出现时, 请特别注意给出的这些提示。

Caution（警告）：出现 " 警告 " 条目时,说明这种状态下或操作时有可能导致设备、软件、数据或其它属性的破坏。

Warning（注意）：出现 " 注意 " 时，意味着在该情况下或执行该操作时可能导致设备整体损坏或系统瘫痪。

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1. Introduction

Overview

Kinemetrics' Altus series of products have several global positioning timing systems available, all of them based on the Global Positioning System (GPS). We use the term “GPS system” to describe these timing systems.

Kinemetrics integrates appropriate GPS options into the system architecture of the Altus recorders to ensure that the recorder’s fundamental time can lock to GPS. As a result, users don’t have to recover real time from a recorded IRIG channel. Supported options and exact configuration of GPS systems vary according to the Altus product line and the model number used in an installation.

This tight integration also allows the recorder to control the power cycling of the GPS, and to retrieve the Altus recorder’s position from the GPS system. Kinemetrics offers two different GPS-compatible products:

- An internal GPS receiver mounted within the recorder itself; the antenna varies slightly from one Altus product line to another (See Chapter 2.)
- An external GPS system; the GPS receiver and antenna are mounted remotely to allow a much greater distance between the recorder and the antenna. (See Chapter 3.)

Table 1-1 lists the option numbers for Altus recorder models.

Table 1-1: Option Numbers for Different Altus Recorder Models

Name	5-meter FOG Antenna	25-meter Bullet Antenna	External GPS System
K2	109450-PL	109460-PL	109470-PL
Mt. Whitney	N/A	109760-PL	109765-PL
Etna	109883-PL	109885-PL	109887-PL
Etna-SI	109883-PL	109885-PL	109887-PL

引言

概述

Kinemetrics＇Altus 的系列产品均有基于全球定位系统的时间服务功能。本手册采用“ GPS 系统 ”来描述这些时间服务体系。

Kinemetrics 将合适的 GPS 选项融入 Altus 记录仪的系统结构，以确保记录仪的基准时间能被 GPS 锁定，以便使用户可以从记录的 IRIG 时间道中恢复出真实的时间来。在 Altus 仪器生产中，严格按照 GPS 提供的功能进行了配置，并将需要的模型数据预装在其中。

这种紧密的结合同样允许记录仪去控制 GPS 加电的时间间隔以及 GPS 系统定位结果的刷新周期。Kinemetrics 公司提供两种不同的 GPS 兼容产品。

- 记录仪自身配置的内部 GPS 接收器：从一种 Altus 生产线到另一种生产线，天线有些微不同（见第 2 章）。
- 外部 GPS 系统：GPS 接收机和天线可以远距离安装，即允许记录仪和天线之间有一个较大的距离（见第 3 章）。

表 1-1 列出了各种 Altus 记录仪配用的天线。

表 1-1 不同的 Altus 记录仪配用的天线

名　称	5m FOG 天线	25m Bullet 天线	外部 GPS 系统
K2	109450-PL	109460-PL	109470-PL
Mt.Whitney	N/A	109760-PL	109765-PL
Etna	109883-PL	109885-PL	109887-PL
Etna-SI	109883-PL	109885-PL	109887-PL

2. Internal GPS Options

Overview

An internally-mounted Kinemetrics GPS system uses an internal GPS receiver board and an external antenna. The two antenna options differ in the length of cable each allows between the GPS antenna and the Altus recorder: two of the GPS systems (109450-PL and 109893-PL) include a 5-meter antenna cable and a FOG antenna. The other two GPS systems (109460-PL and 109760-PL) include a bullet antenna and a 25-meter cable.

The internal GPS receiver does the following:

- Receives data from up to six satellites and creates one-pulse-per-second (PPS) output.
- Synchronizes to UTC (the universal timing code).
- Offers a basic timing accuracy of 5 microsecond (µs) of UTC.
- Has position accuracy of 25m SEP (Spherical Error Probability) or 100m SEP if Selective Availability is turned on.
- Consumes approximately 100 milliampere (mA) of current at 12 volts (V) when the unit is powered on (less in the OFF mode).

Note: Selective Availability is a process that degrades the accuracy of the GPS to users not authorized by the U.S. Department of Defense to have access to the highest levels of GPS accuracy. Unfortunately, the Department of Defense normally has Selective Availability turned on, beyond the control of most GPS users.

How Internal GPS Timing Works

When continuously powered, the GPS system maintains recorder sampling times synchronized very accurately with UTC. The Altus recorder runs from a 14.336 megahertz (MHz) clock produced by a voltage-controlled oscillator (VCXO).

Without a GPS system, the VCXO is adjusted to the correct frequency at the factory using a digital-to-analog converter (DAC). When the GPS is added to an Altus recorder, the 1 PPS output of the GPS is used to adjust the DAC to continuously maintain the frequency at 14.336 MHz regardless of the unit's temperature or the aging of the oscillator.

When the GPS is cycled on and off, what occurs is a little more complicated. First, the GPS is turned on and the recorder adjusts the frequency of the oscillator to 14.336 MHz. The GPS is then turned off and the VCXO slowly starts to drift away from the correct frequency.

The majority of this drift is caused by temperature changes. These temperature changes are monitored by the system. If the temperature is relatively stable, the recorder will keep the GPS off for the time specified by the *Power On Interval* parameter (see the *GPS Configuration* section later in this chapter). At the end of this period, the system turns on the GPS power. If the drift is under ±500 µs, the recorder slowly adjusts the oscillator's frequency to effectively either slow down or speed up the recorder time to realign the sample timing to UTC.

When the sample timing to UTC is realigned, the Altus recorder readjusts the oscillator so its frequency is once again 14.336 MHz. The GPS then powers down until the next power-on time.

If the ambient temperature is changing rapidly, and the system calculates that the expected drift will exceed ±500 µs before the next user specified power-on time, the system powers up the GPS early and corrects the time.

Using this algorithm, the recorder can maintain the sampling time to within ±500 µs, even with GPS power cycling. Because changes in the oscillator frequency are small and are filtered by the phase locked loop of the ADC/DSP board's oscillator, no effects are observed in the data when these updates occur.

Note: In unusual circumstances (such as when a GPS signal is lost for some time and the drift is more than ±500 µs), the GPS unit resets the Real Time Clock (RTC). If the GPS is not in the process of recording an event, the unit changes its time to coincide with the correct UTC time. To realign the system clock to UTC, the unit then corrects the oscillator frequency. The recorder will then duplicate sufficient 2000 samples per second (from 0 to 9 samples spread throughout a 0.1 second/s frame) to realign the ADC/DSP output samples to the system frame boundaries. This realignment causes a small distortion in the data. (Because the unit cannot realign during recording, this can only effect pre-event data.) If the clocks have been re-synchronized in this way, the unit stores that information and displays it in the header information of any event.

Installing the Internal GPS System

Usually, a GPS receiver is factory-installed. If the GPS receiver is purchased later as a recorder upgrade, Kinemetrics ships it with retrofit instructions.

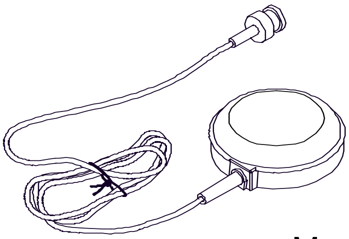
Retrofitting a K2 or Mount Whitney recorder with an internal GPS system in the field requires significant recorder disassembly. If the GPS antenna connector has not been installed, either you or a Kinemetrics technician must completely disassemble the accelerograph system and perform certain machining on the recorder case.

If the GPS receiver is factory-installed, all that's necessary is to mount the GPS antenna and connect the antenna cable to the BNC connector under the front left latch (looking from the front of the unit.)

Antenna Options

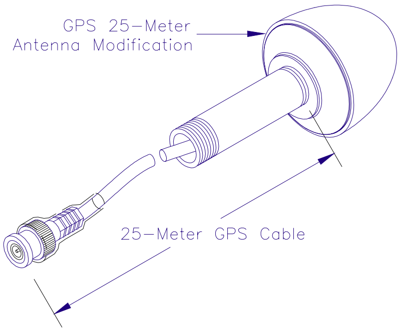
This section describes the mounting requirements for each GPS system antenna.

Mounting a FOG Antenna



Use the 5-meter FOG Antenna (109450-PL, shown left) only with Altus recorders with an internal GPS timing system. Mount the FOG antenna by placing it on a flat surface within 5 meters of the Altus recorder. Make sure the antenna has a good view of the sky, without any obstruction from large buildings or trees.

Mounting a Bullet Antenna



Use the 25-meter bullet antenna (109460-PL and 109760-PL, shown left) with Altus recorders with internal or external GPS timing systems. The antenna has a 3/4" NPT adapter for use with standard pipe fittings.

To mount the antenna, run the antenna cable down through the pipe. Plan the installation so that the cable from the antenna to the Altus recorder (or external GPS box, as explained in Chapter 3) is no longer than 25 meters. Like the FOG antenna, the bullet antenna requires a good view of the sky, without obstruction from large buildings or trees.

The bullet antenna comes screwed onto one end of a 3/4"-diameter NPT adapter pipe (which threads into standard pipe fittings). Within the adapter, the antenna is joined to a Type F connector on one end of a 25-meter coaxial cable. As shown in the bullet antenna illustration, the other end of the 25-meter cable has a BNC connector.

When the antenna's mounting post is installed with a female NPT adapter at the end, the NPT adapter should screw snugly into the female adapter.

Installing Optional GPS Lightning Protection

Neither the FOG antenna or the bullet antenna has built-in lightning protection, due to the high cost of protective devices that can pass the low-level, high-frequency signals used in GPS systems.

> ***Caution***: If the GPS system will operate in an area at high risk for lightening strikes, consider installing a lightning protector on the GPS antenna. Kinemetrics offers a lightning protector device (P/N 109457-PL). Installation is described below.

The optional lightning protector device (P/N 109457-PL) can be used with internal and external GPS timing systems. The lightning protector is a small 3 ½" x 1 ½" x 1 ½" box which contains surge-protection devices to shunt surges from lightning strikes to the ground while still allowing high-frequency signals and the DC power for the active antenna to pass. It has two female BNC connectors, and comes with a 3' (approx. 1 meter) male-to-male BNC extension cable.

Purchase a weatherproofing kit for the lightening protector from Kinemetrics (P/N 790076) if the lightening protector box will be installed outdoors or in a hostile environment.

With an internal GPS timing system, install the lightening protector at the Altus recorder. With an external GPS timing system, install the protector at the external GPS box.

Connect the GPS antenna to the lightning protector as follows:

1. Plug the antenna cable into the protector connector marked *Surge*.
2. For an internal GPS system, take the short BNC male-to-male cable (supplied with the protector), and plug its male connector into the receptacle on the Altus recorder (or the external GPS box, in the case of an external GPS timing system).

   For an external GPS system, take the short BNC male-to-male cable (supplied with the protector), and plug its male connector into the receptacle on the external GPS box.

Make sure to provide a good ground. If at all possible, mount the Protector to a metal plate approximately 12" square (approx. 30.5 cm sq.), with a good low-resistance and low-inductance ground connection. To mount it to the grounding panel, use approximately 20 inch-pounds (2.26 Nm) of torque on the screws.

> ***Caution:*** The lightening protector will not work without adequate grounding.

The strap connecting the grounding panel to earth ground should be as short and heavy as possible (use a copper strap or braid at least 1" wide) to minimize the resistance and inductance of the ground system. Since a skin

effect is present, use a straight strap with as large a surface area as possible, and keep the bends in the strap to an 8" or larger radius.

GPS Configuration

To configure the GPS, make the following three entries on the Timing Parameters dialog box in the QuickTalk Parameter Editor:

- UTC Offset
- Power On Interval
- Maximum Power-On Duration

Refer to the *QuickTalk & QuickLook Software User's Guide* in the back of this binder for instructions on using QuickTalk.

UTC Offset

If the Altus recorder will use local time, set the *UTC Offset* to the difference between local time and UTC time. For example, in the winter months Kinemetrics' U.S. facility is on U.S. Pacific Standard Time; so the UTC Offset is -8 hours.

Note: If the recorder is set to local time, you must manually change the entry in the *UTC Offset* field at the same times of the year when other clocks are adjusted for Daylight Savings Time. Consider using UTC time instead of local time to avoid having to change the *UTC Offset* parameter.

Power-On Interval

The *Power-On Interval* is the number of minutes the Altus recorder will power down the GPS unit before re-applying power to it. If the Altus recorder calculates that a drift of more than ±500 µs will have occurred before the next power-up, it will override this time.

Set the entry in this field to zero and the entry in the *Maximum Power-On Duration* field to non- zero to continuously power the GPS receiver. The suggested setting for this field is 60 minutes.

Maximum Power-On Duration

The *Maximum Power-On Duration* is the maximum number of minutes the GPS receiver is powered up at any one time. The GPS receiver automatically powers down after re-synchronizing the oscillator if the *Power-On Interval* has been set.

If the recorder does not receive a correct GPS time within the number of minutes specified in this field, it automatically powers down the GPS receiver and reports a `Failure to Lock` error.

Set this parameter to zero to disable automatic power-up of the GPS receiver. The suggested setting for this field is 30 minutes.

Caution: Setting the *Maximum Power-On Duration* to less than 30 minutes can cause problems if the recorder does not have sufficient time to receive the almanac after a complete power loss; the recorder might not be able to lock to GPS time at all. A setting lower than 30 minutes will not save power during normal operation because the GPS system powers down as soon as it re-synchronizes the recorder.

With these parameters set, and the GPS antenna connected, the GPS receiver should be powered-on and looking for satellites. This initial power-on can take 10 to 15 minutes while the unit acquires the satellites and downloads the information it needs for a position and time fix. This is because the system will not know its location or have a GPS almanac.

Note: Changes to the GPS parameters take effect the next time the GPS receiver is powered up, or when the Altus recorder is reset.

After making an initial lock, the GPS system should make future locks in only a few minutes because, using backup power supplied by the Altus recorder, the GPS system preserves the almanac and the system’s position in the receiver’s memory.

GPS System Diagnostics

Use the *GPS* command in the Terminal window Diagnostics Editor (accessed via QuickTalk)to monitor the GPS system. The *GPS ON* and *GPS OFF* commands allow you to turn the GPS on and off from the command line.

The *GPS SYNCH* command forces the Real Time Clock (RTC) in the system to synchronize with GPS time. The *GPS STATUS* command displays the current GPS status and when the GPS obtained its last locks, etc.

Finally, the *GPS DIAGNOSTIC* command allows you to make a relatively complete determination of the GPS system's actions. When started, the GPS diagnostic continuously reports which packets of information are being sent between the recorder and the GPS receiver. Press these keys for the following information:

- *H* for the GPS receiver's “state of health” message.
- *Z* for GPS system status.
- *T* to return the current GPS time, if available.
- *C* to synchronize clocks.
- *Q* to quit GPS diagnostics.
- *S* for tracked satellites signal-to-noise ratio.

Note: If the GPS system is powered on for some time and still shows very few satellites with signal-to-noise ratios above 0.0, there is probably a problem with the GPS antenna placement, with the antenna cabling or, less likely, with the GPS receiver itself.

Refer to the *QuickTalk & QuickLook Software User's Guide* at the back of this binder for more information about Terminal window commands.

内部 GPS 的使用

概述

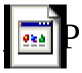
内部安装的 Kinemetrics GPS 系统使用一个内部 GPS 接收板和一个外部天线。视 GPS 天线和 Altus 记录仪之间的距离，可选择不同天线（FOG 和 Bullet 这两种天线的差别在于电缆长度不同）：FOG 天线（109450-PL 和 109893-PL）带一根 5 米的同轴电缆天线，另一种天线（109460-PL 和 109760-PL）较长，包括一个 Bullet 天线头和一根 25 米长的同轴电缆。

内部 GPS 接收器具有如下功能：

- 可接收多达六颗卫星传输来的数据，并每秒输出 1 个脉冲信号（PPS）。
- 与 UTC 同步。
- 提供的时间校正精度达 5μs。
- 25m SEP(球形或然率误差)位置精度或 100m SEP（当选择可用性为开启时）。
- 当设备开启时，12V 电流消耗接近 100mA（设备很少关闭）。

注释：选择可用性（Seleltile Availubility）是一个对普通用户降低 GPS 定位精度的限制过程。遗憾的是，当用户没有获得美国安全局的批准而想获取高精度的 GPS 定位时，美国安全局通常用 Seleltile Availubility 开启的限制，去控制大多数 GPS 用户的定位精度。

内部 GPS 适时器是如何工作的

持续供电时 

PS 系统保持记录仪采样时间与 UTC 有非常精确的同步。Altus 记录仪运行 频率是 14.336MHz，这个频率是由压控振荡器产生的。

没有一个 GPS 系统其 VCXO（压控振荡器）在工厂中采用数模转换器（DAC）调整到正确的频率。当 GPS 安装到 Altus 记录仪时，GPS 的 1 PPS 输出通常去调整 DAC 以迫使记录仪持续保持在 14.336MHz，而不管设备温度或振荡器老化程度如何。

当 GPS 在“开”和“关”反复变换时，发生的情况稍微复杂。首先，GPS 板在获得供电（开启）期间，记录仪调整振荡器频率至 14.336MHz；当 GPS 关闭时，VCXO 开始逐渐漂离这个正确的频率。

这种漂离主要是由温度变化引起的，温度变化可被系统监测出来。如果温度是相对稳定的，记录仪将保持 GPS 关闭，因为 GPS 的加电时间可由“加电间隔参数”指定（详见本章“GPS 配置部分”）。当断电时间结束时，GPS 电源又被加电。如果漂离在±500μs 范围内，记录仪慢慢调整振荡器频率（降低或升高），以便使记录仪按 UTC 时间重新定义采样时间。

当对采样时间按 UTC 时间重新定义的同时，Altus 记录仪就调整一次振荡器的频率到 14.336MHz，然后就关闭 GPS 电源直到下一次加电时间为止。

如果环境温度是迅速变化的，以致系统计算出的漂离将超出±500μs，在下一个使用者修改加电持续时间之前，系统就提前给 GPS 加电，并且修正这个时间。

运用这种方法，即使 GPS 经常加电、断电不断循环，记录仪仍能保持采样时间误差在±500μs 范围之内。因为振荡器频率变化通常是较小的，并且由 ADC/DSP 板的锁相振荡器进行了滤波。当进行时间更新时，对数据的时间序列没有影响。

注释：在不寻常的情况下（如：当 GPS 信号在一段时间收不到且时间漂离超过±500Ms 时），GPS 设备重新启动绝对时钟（RTC）。如果 GPS 在这一时间段内并没有处于记录事件文件的过程中，设备将改变它的时间与正确的 UTC 时间保持一致。随着用 UTC 重建系统时钟，设备也将校准振荡器频率。随后，记录仪将复制足够每秒 2000 个采样点的时间标尺（从 0 到 9 个样品散布到整个 0.1S 的时间区间中）去按系统结构边界重新定义 ADC/DSP 输出样品的时间。这种重新定义的时间会引起数据发生微小的失真。（因为设备不能在记录过程中进行重新定义，上述情况仅仅影响在“事件前”的时间内所记录文件的时间。如果时钟正好在这个过程中被重新同步，设备将在头段文件中存储信息。并可在查看任何记录时间的头段文件时显示这些信息。

安装内部 GPS 系统

通常，GPS 接收器是厂家安装的如果为原有的记录仪升级而需要在后来购买 GPS 接收器时，Kinemetrics 公司会给出新的用法说明。

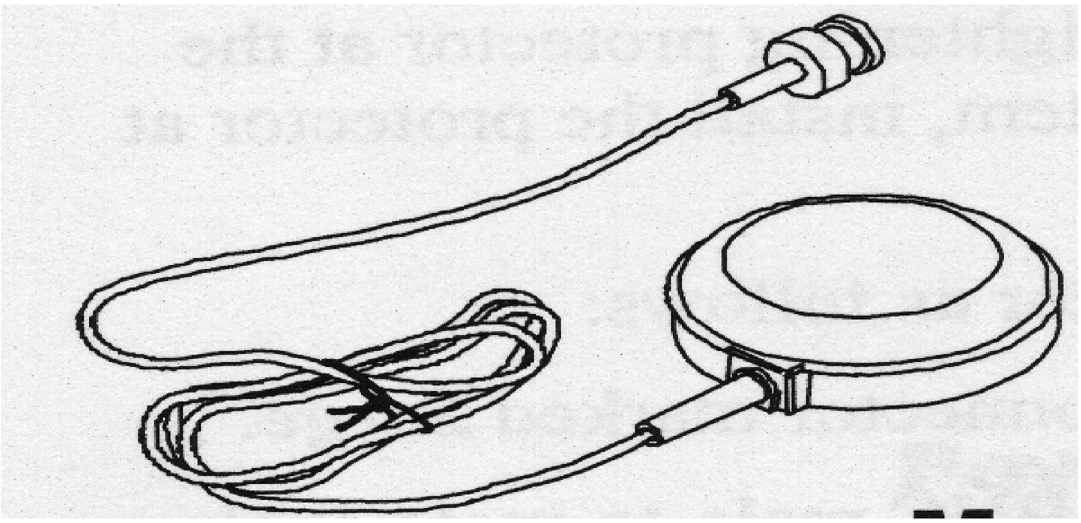
用一套内部 GPS 系统翻新一个 K2 或装备 Whitney 记录仪，这时需要拆开记录仪进行改装，如果 GPS 天线接口都没有安装，你自己或 Kinemetrics 技术员必须打开仪器外壳，彻底拆卸加速度记录仪，执行一种特定的设计安装过程。

如果 GPS 接收器是厂家安装的，使用时还必须装备 GPS 天线，并把天线电缆连接到的 BNC 的锁存器左部插口上（在接收单元的下面可见到）。

天线的安装

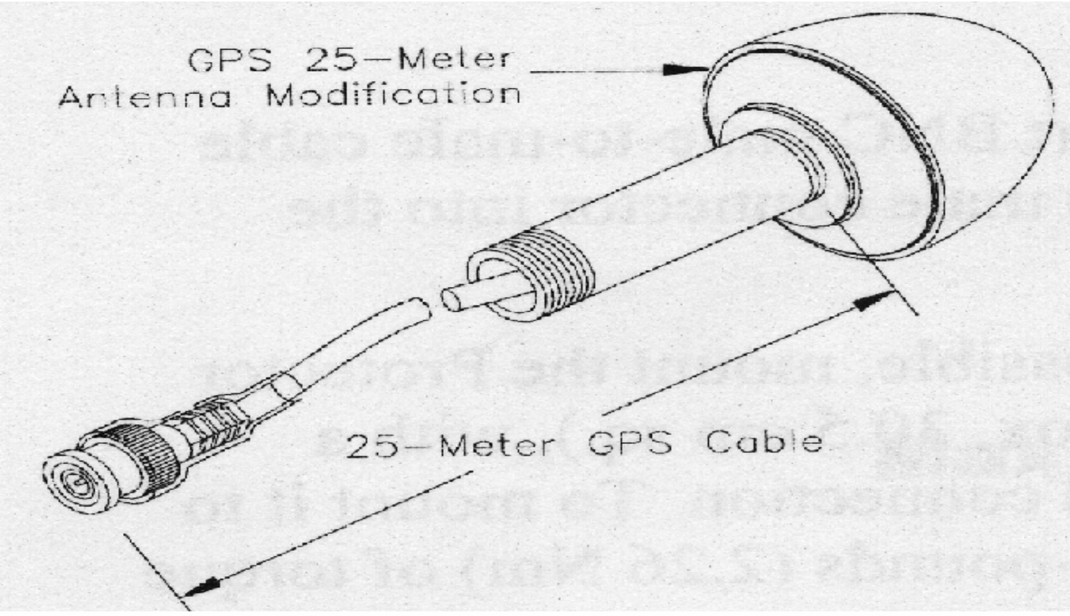
本部分主要介绍各种 GPS 天线的安装。

安装 FOG 天线



5m 长的 FOG 天线（109450-PL，上图示），仅仅适用于装有内部 GPS 适时系统的 Altus 记录仪。把 FOG 天线放在离记录仪 5m 之内的一平坦场地上，将插头插入记录仪插座。确保天线视角开阔，周围没有任何障碍，如：大的建筑或大树。

安装 Bullet（子弹头）天线



25m 长的 Bullet 天线（109460-PL 和 109760-PL，上图　示），适用于带有一个外部或内部 GPS 适时系统的 Altus 记录仪。这种天线有一个 3/4〞 NPT 适配器，它和标准导管装配在一起使用。

安装天线：电缆从导管穿出，将电缆插头插到 Altus 记录仪（或外接的 GPS 接收机，外接接收机见第 3 章讲述）。电缆长度不超过 25m。和 FOG 天线一样，Bullet 天线也需要视角宽广,且没有障碍,如高大建筑和树木。Bullet 天线电缆从 3/4〞直径的 NPT 适配器管的末尾引出。在 25m 同轴电缆末尾连接一个 F 型插头，像在 Bullet 天线照片中显示的那样，电缆的另一端有一个 BNC 连接器。

当天线用 NPT（塑料管）固定时，应将电缆从塑料管中穿过，拧紧与天线的接口。

安装 GPS 雷电保护器

FOG 天线和 Bullet 天线均没有内置的雷电保护设备，主要是由于通常的避雷设备会旁路 GPS 系统中使用的微弱高频信号。

警告：如果在雷电袭击的高风险区安装 GPS 天线，应考虑在 GPS 天线上安装一个雷电保护器，Kinemetrics 公司提供一种雷电保护设备（P/N 109457-PL），其安装方法在下面叙述。

任何避雷器（如 P/N 109457-PL）可以用在内部和外接 GPS 适时系统的天线中。避雷器是一个 3 1/2″×1 1/2″×1 1/2″的小盒子，其中的保护设备将雷击电压引入大地的同时，仍然不使收到的高频信号和供给天线的直流电源中断。它具有两个阴插口，并附带有一根 3 英尺（大约 1 米）长的连接电缆（两端为阳插头）。

如果避雷器安装在野外或环境较为恶劣的地方，应该从 Kinemetrics 公司为它购买一个防雨设备（P/N 790076）。

在内部配置 GPS 实时系统的 Altus 记录仪上，避雷器可以连接到记录仪上，使用外接 GPS 实时系统时，避雷器连接在外部 GPS 上。

按以下步骤将避雷器连接到 GPS 天线上：

1. 将天线电缆插头插入避雷器上标有“ *Surge* ”的插孔。

2. 对于内部 GPS 系统，用那根短的两端带有阳插头的电缆（随避雷器的附件）连接避雷器和 Altus 记录仪（在使用外接 GPS 适时系统时，即指外部 GPS 接收机）。

使用外接 GPS 系统时，用那根短电缆（随保护器提供），用其阳插头插到外部 GPS 接收机上。

确保提供一个好的工作条件。如果可能，将避雷器安装在一个大约 12 平方英寸（约 30.5cm2）的金属板上，要求该板可靠接地（低阻抗和低感抗）。将避雷器用螺栓（转矩大约为 2.26 牛顿米）固定在金属板上。

警告： 如果没有可靠接地，避雷器是不会正常工作的。

连接避雷器的接地板和地线的扁线应该尽可能的短和粗（常用一个铜条或宽 2.5cm 以上的铜编织带），以使接地系统的阻抗和感抗达到最小。因为电流的趋肤效应，常用一个直的且其表面积尽可能大的扁线，扁线曲率半径应为 20cm 或更大。

GPS 配置

配置 GPS 需要使用 QuickTalk 参数编辑器中的时间参数（Timing Parameters）对话框，设置：

- 标准时间差（UTS offset）
- 加电间隔
- 最大加电持续时间

参照 QuickTalk 和 QuickLook 使用手册中关于 QuickTalk 的用法说明。

标准时间差（UTC Offset）

如果 Altus 记录仪使用地方时，就要用这个参数设置地方时和 UTC 时间之间的时间差。如，在冬季，Kinemetrics 美国设备用的是太平洋时间，于是标准时间差设为－8 小时。

注释：如果记录仪启动的是地方时，当另一时钟被调整为夏令时的同时，就必须在标准时间差的范围内用手工改变这一条目。为此可考虑使用 UTC 时间代替地方时，以避免手工修改标准时间差参数。

加电间隔

“加电间隔”以分钟为单位。在重新给 GPS 设备加电之前，Altus 记录仪将不给 GPS 设备供电。如果在下次加电前 Altus 记录仪计算出的漂离时间超过±500μs, 加电间隔也显示“超时”。如果把该参数设为 0，并且把“最大加电持续时间”不设为 0，即：给 GPS 接收器不间断加电。这个参数的建议设置值为 60 分钟。

最大加电持续时间

最大加电持续时间是任何一次 GPS 接收器加电所持续的最长时间（分钟），如果加电间隔已被确定，当振荡器重新同步后，GPS 接收器将自动下电。

如果记录仪不能在最大加电持续的时间（分钟）内接收到正确的 GPS 时间，它也将自动下电，并提示一个“Failure to Lock（锁定失败）”的出错信息。

如果将这个参数设置为零，可以禁止 GPS 接收器自动加电。这个参数建议设置值为 30 分钟。

警告：如果设置的该参数小于 30 分钟，那么当一个完整的加电过程完成后，GPS 接收器没有充足的时间去获得正确的时间，将可能引起一些问题，即记录仪根本不能锁定 GPS 时间，因此，设置值小于 30 分钟，将不能解决正常运行过程中的加电问题，因为一旦与记录仪重新同步，GPS 系统同时也自动掉电。

诸如这些参数设置、GPS 天线连接、GPS 接收器加电等完成后，GPS 系统将开始搜寻卫星，初始化过程大约化费 10—15 分钟，其中包括计算卫星和调出相关信息（GPS 天线位置和记录仪时间系统）。这就是为什么记录系统开始时并不知道它的位置，也没有 GPS 时间的原因。

注释：改变 GPS 参数后，只能在 GPS 接收器下次加电时生效，或当 Altus 记录仪重新启动时生效。

当指定了“初始锁定”状态后，因为使用了 Altus 记录仪的电源维持电平，在接收器的记忆系统中预存了 GPS 系统的年历和记录器的位置，GPS 系统将使未来的锁定过程于几分钟内迅速完成。

GPS 系统诊断程序

在终端窗口的诊断程序编辑器（Terminal window Diagnostics Editor, 由 QuickTalk 可调出）中，用 GPS 指令可以监控 GPS 系统，用 GPS ON 和 GPS OFF 指令可以随时打开和关闭 GPS 系统。

GPS SYNCH 指令使记录系统的绝对时间（RTC）与 GPS 时间同步，GPS STATUS 指令可显示当时的 GPS 循环状态以及最后一次锁定状态是何时完成的等等。

最后，*GPS DIAGNOSTIC* 指令可以建立 GPS 系统和记录仪之间的信息联系。当启动该指令时，GPS 诊断程序会持续不断地在记录仪和 GPS 接收器之间传送信息，并在 PC 机显示。按字母键可以获取以下信息：

- *H* GPS 接收器“ 正常状态 ”信息；
- *Z* GPS 系统状态；
- *T* 若 GPS 时间可用，返回到当前的 GPS 时间循环；
- *C* 使时钟同步；
- *Q* 退出 GPS 诊断程序；
- *S* 计算所跟踪卫星的信噪比。

注释：如果 GPS 系统加电之后很长时间仍然只有很少几个卫星的信噪比超过零，其原因多是 GPS 天线位置不当，也可能是天线敷设、连接方面的问题，很少可能是 GPS 接收器自身的问题。

关于终端窗口指令的更多信息可参考 QuickTalk 和 QuickTook 软件使用手册的末尾。

3. External GPS Options

Overview

Even if it not feasible to locate a GPS antenna close to the recorder, the recorder can still use GPS timing by using the external GPS option.

The elements of the external GPS option are as follows:

- A bullet antenna with a 25-meter cable.
- An external assembly that contains the GPS receiver.
- A custom power control and line-driving card which transmits GPS information from the external GPS box to the Altus recorder.
- An interface card in the recorder.

External GPS transmissions can be sent over 120 Ohm impedance twisted-pairs. The cable between the recorder and the antenna can be up to 4,000 feet long.

How External GPS Timing Works

The external GPS option uses the same antenna-receiver combination as an internal GPS system (in which the receiver is mounted inside the recorder). In the external GPS system, the receiver is mounted in an external box.

The CMOS-level serial data signal created by the recorder that controls the GPS and the serial data transmitted from the GPS are translated into RS-485 differential signals that can be transmitted along a twisted-wire pair.

Similarly, the 1 PPS marker from the GPS receiver is stretched to a pulse length of 1 millisecond (ms), and is also transmitted by using an RS-485 driver.

These three signals are required in all installations. The Altus recorder generates the next signal, which controls the power to the GPS receiver. Transmitted as an RS-485 signal, the signal generates a logic power-on

signal in the box, which then applies a power-on signal to the box's switching regulator, thus powering up the GPS receiver.

Kinemetrics provides this function so that, even if AC power is not readily available, the amount of power consumed by the system is minimized. The +12V power to the external GPS is supplied along another cable pair. The cable's resistive drop must be low enough to allow the system to function.

The line drivers and receivers on the interface board and the backup RAM power in the GPS receiver are continually powered by a low drop-out voltage regulator. The power to the GPS receiver is only enabled when the Altus recorder turns on the “power control” signal line.

Two-stage transient protection networks protect all signal lines into the external GPS and into the Altus recorder. These networks consist of a gas arrestor, a series impedance, and a shunt TransGuard semi-conductor element. While nothing can protect against a direct lightning strike, this form of transient protection provides a good shield against induced transients from nearby strikes.

Which interface card the external GPS option uses depends on the Altus recorder to which it is connected. For K2 and Etna systems, the normal installation uses a military-style connector that protrudes through one of the Altus recorder's front panel positions. For the Mt. Whitney system, the board will be mounted in the main system box and includes terminal strips to allow you to terminate the cable directly into a screw-type terminal strip.

For any Altus recorder, the use of an external GPS is transparent once the system is installed. The software requires no modification and the same GPS diagnostics are available as for the internal option. The only unique consideration is the external GPS option's higher electrical-current requirement. The unit draws approximately 10 mA with the GPS off and 180 mA from the battery with the GPS on. Remember that the position reported will be that of the external box. The timing signal will be delayed approximately 60 µs due to transmission delays in the line driver and cables.

Cabling & Power Requirements

The external GPS requires four signal-pairs and one power cable. Use high-quality computer data cables with an overall shield and drain wire similar to Belden 9844 cable for signal-pairs. Twisted pairs should have a nominal impedance of 120 Ohm at 1 MHz, a capacitance of approximately 12 pF per foot, and should be either 24 or 26 AWG copper conductors.

Note: Make sure that the internal insulator on the cable is made of low-loss dielectric material (such as linear low-density polyethylene). Do not use PVC; it can cause excessive loss. The cable jacket can be made of any suitable material because the jacket does not affect the cable's electrical properties.

Use cable with a diameter between 0.27 - 0.48", and sized for power, as shown in Table 3-1, according to the cable's intended length. Kinemetrics recommends a custom cable with this system consisting of four 26 AWG twisted-pairs for the signal transmission, and a 16 AWG pair for the power transmission. Order this cable (P/N 700381) from Kinemetrics by the foot for distances of up to 1,500 ft (450m).

If the necessary twisted-wire pairs are available for data transmission, but suitable power cables are not, adopt one of the approaches described in Table 3-1:

Table 3-1: Maximum Cable Lengths for Power

AWG	Resistance /1000'	Max Length /'	No Pairs 500'	No Pairs 1000'	No Pairs 1500'
28	64.9	100	5	10	15
26	37.3	170	3	6	9
24	23.3	250	2	4	6
22	14.7	400	2	3	4
20	10.3	500	1	2	3
18	5.3	1000	1	1	2
16	3.6	1500	1	1	1
14	2.3	2500	1	1	1

Multiple Twisted-Pairs for Power Connections

To provide a sufficient low-voltage drop, connect multiple twisted-pairs together. This will provide sufficient voltage at the external GPS regulator to ensure system functioning. Refer to Table 3-1 for the required number of twisted-pairs.

Remote Power Supply

As an alternative, supply remote power for the GPS system (approximately 180 mA at 12V).

Caution: Isolate the power supply so that no ground connections are made to the external GPS box. If the power supply is not isolated, it can create ground loops that might severely affect system performance.

Use the connection described above in one of two modes:

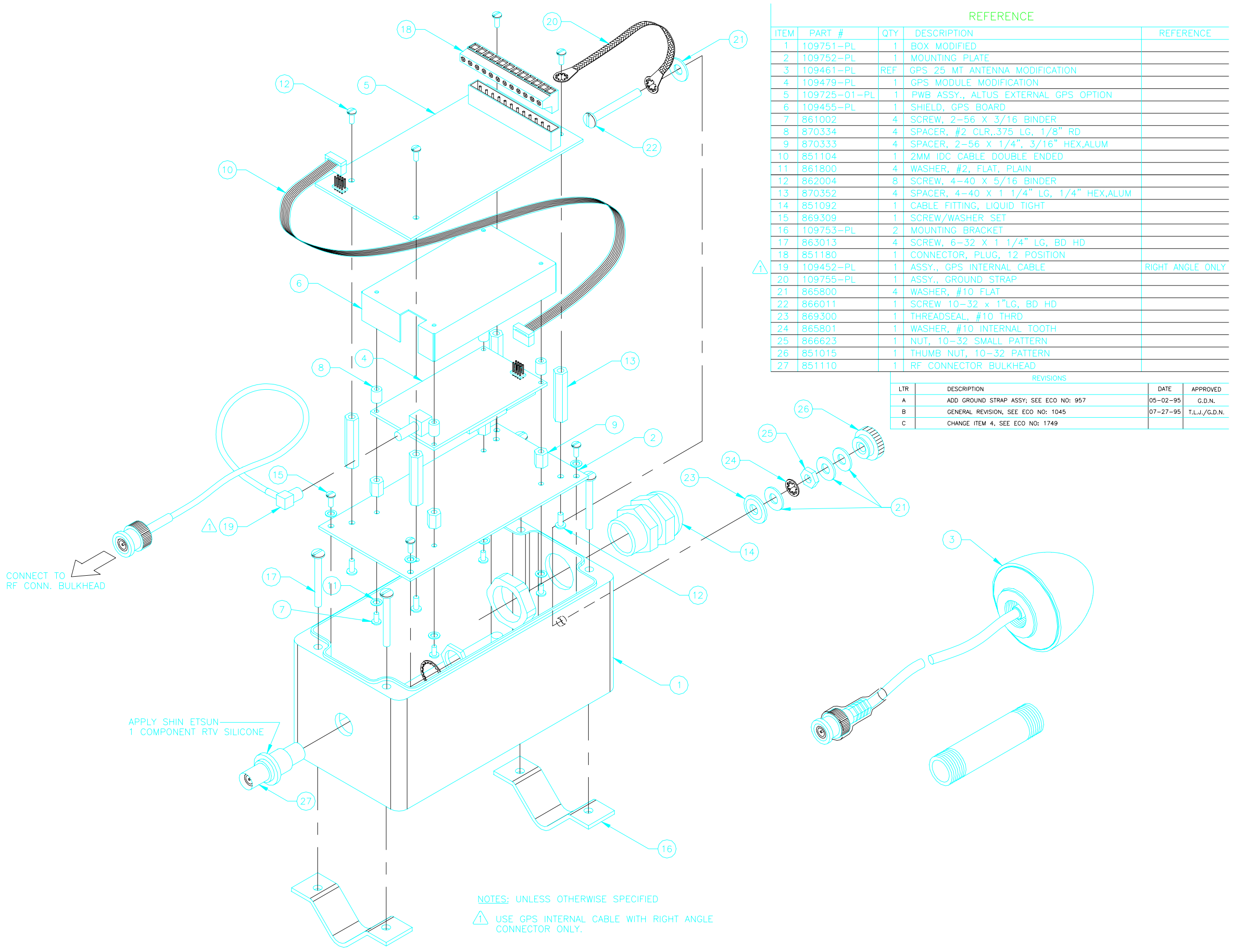
- In the first, make the GPSON twisted-pair connection from the Altus recorder to the external GPS box, then control the power from the Altus recorder. Full power is consumed only when the GPS receiver is activated by the recording system.

- In the second, the GPS unit is powered continuously without a GPSON twisted-pair connection. For this approach, set Jumper X1 on the board in the REM position (1 connected to 2), and remove Jumper X3.

Connecting the External Box

Figure 3-1 provides an exploded assembly drawing of the external GPS box. Table 3-2 shows the connections at the external GPS box and the suggested color codes for use with KMI cable (P/N 700381).

Figure 3-1: Exploded View of the External GPS Box Assembly



ITEM	PART #	QTY	DESCRIPTION	REFERENCE
1	109751-PL	1	BOX MODIFIED	
2	109752-PL	1	MOUNTING PLATE	
3	109461-PL	REF	GPS 25 MT ANTENNA MODIFICATION	
4	109479-PL	1	GPS MODULE MODIFICATION	
5	109725-01-PL	1	PWB ASSY., ALTUS EXTERNAL GPS OPTION	
6	109455-PL	1	SHIELD, GPS BOARD	
7	861002	4	SCREW, 2-56 X 3/16 BINDER	
8	870334	4	SPACER, #2 CLR,.375 LG, 1/8" RD	
9	870333	4	SPACER, 2-56 X 1/4", 3/16" HEX,ALUM	
10	851104	1	2MM IDC CABLE DOUBLE ENDED	
11	861800	4	WASHER, #2, FLAT, PLAIN	
12	862004	8	SCREW, 4-40 X 5/16 BINDER	
13	870352	4	SPACER, 4-40 X 1 1/4" LG, 1/4" HEX,ALUM	
14	851092	1	CABLE FITTING, LIQUID TIGHT	
15	869309	1	SCREW/WASHER SET	
16	109753-PL	2	MOUNTING BRACKET	
17	863013	4	SCREW, 6-32 X 1 1/4" LG, BD HD	
18	851180	1	CONNECTOR, PLUG, 12 POSITION	
19	109452-PL	1	ASSY., GPS INTERNAL CABLE	RIGHT ANGLE ONLY
20	109755-PL	1	ASSY., GROUND STRAP	
21	865800	4	WASHER, #10 FLAT	
22	866011	1	SCREW 10-32 x 1"LG, BD HD	
23	869300	1	THREADSEAL, #10 THRD	
24	865801	1	WASHER, #10 INTERNAL TOOTH	
25	866623	1	NUT, 10-32 SMALL PATTERN	
26	851015	1	THUMB NUT, 10-32 PATTERN	
27	851110	1	RF CONNECTOR BULKHEAD	

LTR	DESCRIPTION	DATE	APPROVED
A	ADD GROUND STRAP ASSY; SEE ECO NO: 957	05-02-95	G.D.N.
B	GENERAL REVISION, SEE ECO NO: 1045	07-27-95	T.L.J./G.D.N.
C	CHANGE ITEM 4, SEE ECO NO: 1749		

Make the connections to the external GPS box as follows:

1. Feed the cable through the cable gland until the excess cable protrudes inside the box.
2. Remove the terminal strip from its socket by pulling upward. Strip approximately 1/4" of insulation from each wire and insert the wire into the terminal strip in the correct position as shown in the silk-screen or the table.
3. Tighten the screw to hold the wire.

Table 3-2: External GPS Box Connections

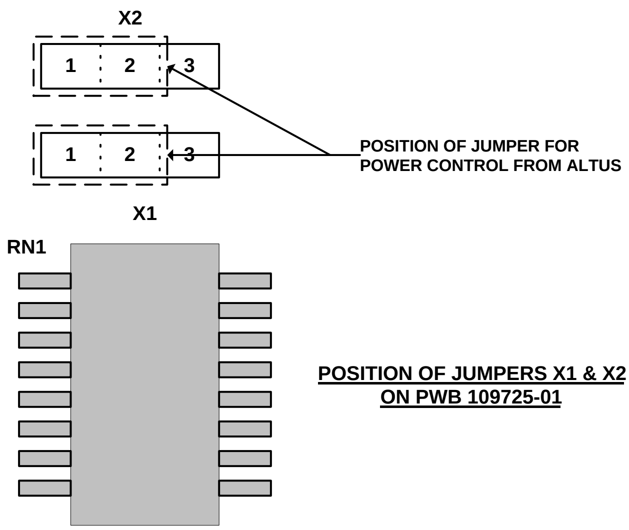
Terminal Strip Position	Wire Color Code	Signal Name	Signal Type	Description
TS1-1	Red	+12V	Power	+12V Power for a remote GPS
TS1-2	Black	GND	Common	System power common
TS1-3	White/Blue	+GPSON	Signal Input	GPS Power On signal (+)
TS1-4	Blue/White	-GPSON	Signal Input	GPS Power On signal (-)
TS1-5	White/Orange	+RXD	Signal Input	GPS input serial data from the recorder (+)
TS1-6	Orange/White	-RXD	Signal Input	GPS input serial data from the recorder (-)
TS1-7	White/Green	+TXD	Signal Output	GPS output serial data to the recorder (+)
TS1-8	Green/White	-TXD	Signal Output	GPS output serial data to the recorder (-)
TS1-9	White/Brown	+1HZ	Signal Output	GPS timing signal to the recorder (+)
TS1-10	Brown/White	-1HZ	Signal Output	GPS Timing Signal to the recorder (-)
TS1-11	Black	GND	Common	System power common.
TS1-12	Shield	PGP	Chassis	Protective ground plane connection

4. When all the connections have been made, insert the terminal strip back into the socket.
5. Adjust the cable length by pulling the excess out of the box to make a neat service loop, then tighten the cable gland to give a watertight connection.
6. Before installing the box on the mounting mast, set the board jumpers to the correct position as shown in Table 3-3.

Table 3-3: Board Jumpers

Jumper	Installation	Comments
X1	Connect 1 to 2	Controls the default state of the GPSON signal. In this position (1 to 2), the signal is normally off. Allows the recorder to assert the line to power the system. Connecting 2 to 3 causes the signal to remain on; used if the unit is remotely powered. **Note:** X1 and X2 must be in same position.
X2	Connect 1 to 2	Controls the default state of the GPSON signal. In this position (1 to 2), signal is normally off. Allows the recorder to assert the line to power the system. Connecting 2 to 3 causes signal to be on and would be used if remote power is used for the unit. **Note:** X1 and X2 must be in same position.
X3	Installed	Controls the 120 Ω AC terminator on the GPSON line. (Remove if the recorder will be continuously powered by a remote 12V supply.)
X4	Installed	Controls the 120 Ω DC terminator on the GPSRXD line.
X5	Not Installed	Controls the 120 Ω DC terminator on the GPSTXD line
X6	Not Installed	Controls the 120 Ω AC terminator on the 1 Hz line.

Figure 3-2: Setting Position, Jumper X1 & X2



Note: To improve the transmission quality of the GPS system with discrete terminating networks, do not install X3 - X6. Install the terminating networks directly on to the terminal strips instead.

7. Mount the bullet antenna and external GPS box in their permanent locations. For satisfactory reception, make sure the bullet antenna has a good view of the sky, without obstruction from large buildings or trees. The external GPS box should be at least 6 feet (2 meters) away from the antenna to prevent the box from causing electrical interference.

The bullet antenna comes with a 3/4" NPT adapter that you can screw into standard pipe fittings. Run the antenna cable down through this pipe and over to the external GPS box.

The external GPS box can be mounted to a rigid pole of a diameter from 0.75" to 1.5", using the supplied pole clamps and included screws. Or, mount the box to a custom mounting with the box's four mounting holes (if connected by a pencil line, they would form a rectangle of dimensions 5.82" (148mm) by 1.97" (50mm).

8. Connect the BNC connector on the antenna cable to the connector on the external GPS box.
9. Neatly coil the surplus antenna cable and attach it to the box.

> ***WARNING!*** *Electrocution hazard. Potentially lethal voltages can pass between the circuit and the local earth ground if the grounds are installed incorrectly at either end. Isolate the external GPS from the local earth ground apart from the transient current shunting. Only a qualified technician should service the equipment. Make sure to observe all local regulations.*

10. Use a short braid to connect the box's grounding stud to a local earth ground.

    The ground stud connects to the protective ground plane (PGP) of the circuit board. The PGP only connects to the rest of the circuitry through the gas arrestor transient protectors. It does not present a DC path in normal conditions, but shunts transient current pulses to earth.
11. Lightning protector device users (P/N 109457-PL) should follow the instructions in Chapter 2 of this manual to connect the protector to an internal GPS timing system. Connect the ground to a local earth ground.
12. Replace the cover on the external box.

The external GPS has a fuse (F1) on the +12V power output. If it blows, replace it with a (1A) Slow-Blow fuse (P/N 840524).

Connecting to an Altus Recorder

Refer to Table 1-1 to check which GPS interface is installed in your Altus recorder.

All GPS interface cards provide RS-485 receivers and drivers, and offer transient protection for the interconnecting cable. The connection methods and the physical board layout vary, depending on whether the unit connects to a terminal strip or to a military-style connector.

GPS to a K2 or Etna Recorder

The external GPS option for a K2 (109470-PL) or Etna (109887-PL) recorder consists of the external GPS box and a board on the recorder with an attached connector mounted to the front right side option area. This option is normally factory-installed; a field retrofit will include separate instructions with the unit.

The external GPS option should be connected with the mating connector supplied by Kinemetrics with the GPS option (P/N 851185, Burndy 851-06EC14-12PN50). If using Kinemetrics cable 700381, refer to Table 3-4 for wire descriptions, recommended color codes, and information about connector terminals to which the wire should be soldered.

Table 3-4: Installation Connections for the GPS and K2 or Etna Recorders

J. Connector Pin	Wire Color Code	Signal Name	Signal Type	Description
J	Red	+12V	Power	+12V power to the remote GPS
K	Black	GND	Common	System power common
A	White/Blue	+GPSON	Signal Input	GPS Power On signal to the external GPS (+)
B	Blue/White	-GPSON	Signal Input	GPS Power On signal to the external GPS (-)
G	White/Orange	+RXD	Signal Input	GPS input serial data to the external GPS (+)
H	Orange/White	-RXD	Signal Input	GPS input serial data to the external GPS (-)
E	White/Green	+TXD	Signal Output	GPS output serial data from the external GPS (+)
F	Green/White	-TXD	Signal Output	GPS output serial data from the external GPS (-)
C	White/Brown	+1HZ	Signal Output	GPS timing signal from the external GPS (+)
D	Brown/White	-1HZ	Signal Output	GPS timing signal from the external GPS (-)
L	Black	GND	Common	System power common
M	Shield	PGP	Chassis	Protective ground plane connection

Assemble cable connector as follows:

1. Strip back the outside cable jacket to expose approximately 0.7" of the twisted-pairs and the overall shield.
2. Twist and solder the overall braided shield to a short length of wire. (The wire must be long enough to connect to Pin M on the connector.)
3. Protect the soldered joint with shrink tubing.
4. Thread the black strain-relief grommet and back shell onto the wire.
5. Insert the wires into the appropriate holes in the gray rubber seal until they protrude through.
6. Strip the insulation of the individual wires to about 0.15".
7. Solder each wire into the appropriate solder cup on the connector.
8. Push home the gray rubber seal and screw down the back shell.
9. Correctly position the strain-relief grommet on the jacket cable and screw the two clamp pieces together to firmly hold the cable.

The cable is ready to be connected to a K2 or Etna recorder.

Set the board jumpers to the correct position as described in Table 3-5. These positions are factory-configured and do not need to be altered in most installations.

Table 3-5: Correct Board Jumper Positions

Jumper	Installation	Comments
X1	Not Installed	Not used on the interface board
X2	Not Installed	Not used on the interface board
X3	Not Installed	Controls the 120 Ω AC terminator on the GPSON line. (Remove if the unit will be continuously powered by a remote 12V supply.)
X4	Not Installed	Controls the 120 Ω DC terminator on the GPSRXD line
X5	Installed	Controls the 120 Ω DC terminator on the GPSTXD line
X6	Installed	Controls the 120 Ω AC terminator on the 1 Hz line

Note: If you are trying to improve the transmission quality of the system with discrete terminating networks, do not install X3 through X6. Install terminating networks directly onto the terminal strips instead.

When these steps are completed, the external GPS system is installed. Verify system operation by using the GPS commands described in the *GPS System Diagnostics* section above.

The external GPS interface board has a fuse (F1) on the +12V power output. If this fuse blows, replace it with a (1A) Slow-Blow fuse (P/N 840524).

GPS to a Mt. Whitney Recorder

Prepare the GPS cable for proper connection to a Mt. Whitney recorder as follows:

1. Feed the cable through the conduit opening until a sufficient length extends inside the Mt. Whitney recorder enclosure.
2. Remove the terminal strip from its socket by pulling upward. Strip approximately 1/4" of insulation from each wire, then insert each wire into the terminal strip in the correct position to connect to the recorder's interface board as shown on the silk-screen or in Table 3-6.

Table 3-6: Mt. Whitney Terminal Strip/Interface Board Connections

Terminal Strip Position	Wire Color Code	Signal Name	Signal Type	Description
TS1-1	Red	+12V	Power	+12V power to the remote GPS
TS1-2	Black	GND	Common	System power common
TS1-3	White/Blue	+GPSON	Signal Input	GPS Power On signal to the external GPS (+)
TS1-4	Blue/White	-GPSON	Signal Input	GPS Power On signal to the external GPS (-)
TS1-5	White/Orange	+RXD	Signal Input	GPS input serial data to the external GPS (+)
TS1-6	Orange/White	-RXD	Signal Input	GPS input serial data to the external GPS (-)
TS1-7	White/Green	+TXD	Signal Output	GPS output serial data from the external GPS (+)
TS1-8	Green/White	-TXD	Signal Output	GPS output serial data from the external GPS (-)
TS1-9	White/Brown	+1HZ	Signal Output	GPS timing signal from the external GPS (+)
TS1-10	Brown/White	-1HZ	Signal Output	GPS timing signal from the external GPS (-)
TS1-11	Black	GND	Common	System power common
TS1-12	Shield	PGP	Chassis	Protective ground plane connection

Table 3-7: Correct Board Jumper Positions

Jumper	Installation	Comments
X1	Not Installed	Not used
X2	Not Installed	Not used
X3	Not Installed	Controls the 120 Ω AC terminator on GPSON line. (Remove if the unit will be continuously powered by a remote 12V supply.)
X4	Not Installed	Controls the 120 Ω DC terminator on the GPSRXD line
X5	Installed	Controls the 120 Ω DC terminator on the GPSTXD line
X6	Installed	Controls the 120 Ω AC terminator on the 1Hz line

3. Tighten each screw to hold each wire.
4. When all the connections are made, insert the terminal strip back into the socket.
5. If necessary, adjust the cable length by pulling the excess out of the box to make a neat service loop.
6. Set the board jumpers to the correct position as shown in Table 3-7.

Note: If you are trying to improve the transmission quality of the system by using discrete terminating networks, do not install X3 through X6. Install terminating networks directly onto the terminal strips instead.

When these steps are completed, the external GPS system is installed. Verify system operation by using the GPS commands described in the *GPS System Diagnostics* section above.

The external GPS interface board has a fuse (F1) on the +12V power output. If this fuse blows, replace it with a (1A) Slow-Blow fuse (P/N 840524).

Custom Terminating Networks

To configure the Altus recorder to operate using lower power levels, to transmit over different cable impedances, or to try to allow cables which exceed the 4,000 feet maximum transmission length, install custom AC or DC terminators in the terminal strips.

DC terminators are simply resistors that match the impedance of the cable. The RS-485 drivers have a nominal source impedance of 120 Ohms. At the receiving end, the terminating resistance can be adjusted to better match the cable.

To save power, replace the DC terminations with an AC termination matched to the cable length; this requires installation of a shunt network consisting of a resistor with the impedance of the cable and a capacitor.

Make sure the capacitor's value is approximately 13 pF/ft of the cable length. The terminating network should be installed on the terminal strips. Remove the jumpers connecting the fixed terminators (X3 - X6).

Note: Use of a custom-terminating network requires monitoring of the waveforms on the cable and experience with the use of an oscilloscope. Attempt this only when absolutely necessary to achieve transmission with an existing long cable, or to minimize power consumption.

外部 GPS 的使用

概述

即使不能将 GPS 天线安装得离记录仪很近，记录仪仍旧能够通过外接 GPS 接收机实现时间同步。

外接 GPS 接收机的套件如下：

- 一条带 25m 电缆的 Bullet 天线；
- 一套包含 GPS 接收器的外部接收设备；
- 将 GPS 信息从外部 GPS 接收机传到 Altus 记录仪的用户控制开关和线性驱动卡；
- 用于记录仪内部安装的接口卡；

外部 GPS 转换器的输出信号用阻抗大于 120 欧姆的双绞线传送。连接记录仪和天线的双绞线长度可达 1200 米。

外部 GPS 适时器是如何工作的

如同内部 GPS 系统一样，外部 GPS 使用同样的天线接收器组件（只不过前者的接收器是安装在记录仪内部的）。在外部 GPS 系统中，接收器装在记录仪之外。

输出幅度为 CMOS 电平的串行信号，由控制 GPS 接收器工作和控制 GPS 接收器数据传输的记录仪产生。来自 GPS 的串行信号转换后送到 RS-485 标准接口，再通过双绞线传送给记录仪。

同样，从 GPS 接收机发出的 1 PPS 时标，也可扩展至每毫秒一个脉波，并通过 RS-485 接口输出。

这三种信号在所有的安装过程中都需要。Altus 记录仪发出下一个信号，此信号能控制 GPS 接收机的供电：RS-485 发出一个转换信号，该信号产生一个逻辑加电指令，使 GPS 接收机的转换调节器动作，这样就实现了给 GPS 接收器供电。

因为并不是在任何场合都有交流电，Kinemetrics 公司就提供直流供电功能，并设计该系统消耗的电能为最小限度。通过另一个电缆线把 12V 的直流电压送到外部 GPS 接收机。但电缆线的阻抗引起的压降不能太大，应满足 GPS 的供电要求。

接口板上的线性驱动器和 GPS 接收器以及 GPS 接收器内备份 RAM 的电源供给必须保证连续，其电压调节器的损耗应小。只有当 Altus 记录仪接通了" 开关控制（Power control）"这个信号线时，才能启动 GPS 接收器的供电。

二级瞬时保护网络保护所有进入外部 GPS 和 Altus 记录仪的信号线。这些网络由气体放电器、若干电阻和一个半导体分流器组成。无法抗拒的直击雷来临时，这种瞬时保护装置可以充当抵御附近任何电脉冲的保护罩。

外部 GPS 所用的接收卡的种类，视其所连接的 Altus 记录仪略有区别。对于 K2 和 Etna 系统，通常安装一种军用连接器，此连接器接到记录仪的前部面板上。对于 Mt.Whitney 系列的记录仪，此接收卡以及直接进入连接器内部终端的螺旋状电缆，一并可安装在记录仪的主系统箱内。

对于任何 Altus 记录仪，一旦系统安装完毕，外部 GPS 接收器的应用就很容易了。包括软件的使用、GPS 系统诊断程序等都与内部 GPS 的操作方法完全相同。唯一不同的是外部 GPS 要求供电电流较大。设备运行时，GPS 在待机状态需电池供电 10mA,而 GPS 在工作状态时需 180mA 的供电电流。切记 GPS 的定位结果是指外部 GPS 接收器的位置。由于在线性驱动器和电缆中的传输延时，适时信号可能会延迟大约 60 微秒。

电缆及供电要求

外部 GPS 需要四根信号线和一对供电电缆。 计算机的电缆需要带有防护套的防水线（例如 Belden 9844 电缆）。双绞线在 1MHz 频点阻抗约为 120 欧姆，每米分布电容 38pF（相当于美国线规的 24#或 26#铜线）。

注：应确保电缆内部的绝缘体用低衰耗的电介质材料制造（例如线性低密度聚乙烯），不要用 PVC 材料，它有可能造成很大的衰耗。电缆的外套管可用合适的材料制造。因为此套管并不影响电缆的导电性能。

电缆线的直径应在 7-12mm，根据供电电缆的长度，由表 3-1 选择线号和用量。Kinematics 公司推荐的一种电缆，它有四条 26#的传输信号双绞线和 16#供电双绞线，从 Kinematics 公司订购的这种电缆（P/N 700381）供电长度可达 450 米。

如果传输数据的双绞线已经有了，而没有合适的供电电缆，可依表 3-1 购买电源线。

表 3-1 供电电缆最大长度表

线规（AWG）	阻抗/1000（欧姆）	最大长度/卷（英尺）	距离 500 英尺（卷）	距离 1000 英尺（卷）	距离 1500 英尺（卷）
28	64.9	100	5	10	15
26	37.3	170	3	6	9
24	23.3	250	2	4	6
22	14.7	400	2	3	4
20	10.3	500	1	2	3
18	5.3	1000	1	1	2
16	3.6	1500	1	1	1
14	2.3	2500	1	1	1

用于供电的多用双绞线

当供电距离一定时，为了减小电压降，需将多根双绞线并联在一起，这样才可给外部 GPS 接收器提供足够的电压以确保系统正常工作。每千英尺（每 330 米）的电阻值参考表 3-1。

远程遥控供电

为外部 GPS 接收器的远程供电容量大约为 12V × 180mA。

警告：要确保给外部 GPS 接收器供电时，电源无接地端，否则会产生接地回路，以至严重影响系统的性能。

可用以下两种连接模式之一：

- 第一种：用双绞线连接 Altus 记录仪至外部 GPS 接收器，由 Altus 记录仪控制 GPS 的开关。只有当 GPS 接收器被记录仪系统激活后才可能获得从记录仪输送的全部工作电流。
- 第二种：GPS 设备不用遥控双绞线连接时也能连续供电：这时将主板上的跳线 X1 设置于 REM 位（1 与 2 连接）。同时拔掉跳线 X3。

连接外部 GPS 接收器盒

图 3-1 是外部 GPS 接收器的装配总成图。表 3-2 显示了在使用 KMI（P/N 700381）记录仪时，连接外部 GPS 接收器的连线的颜色代码（推荐）。

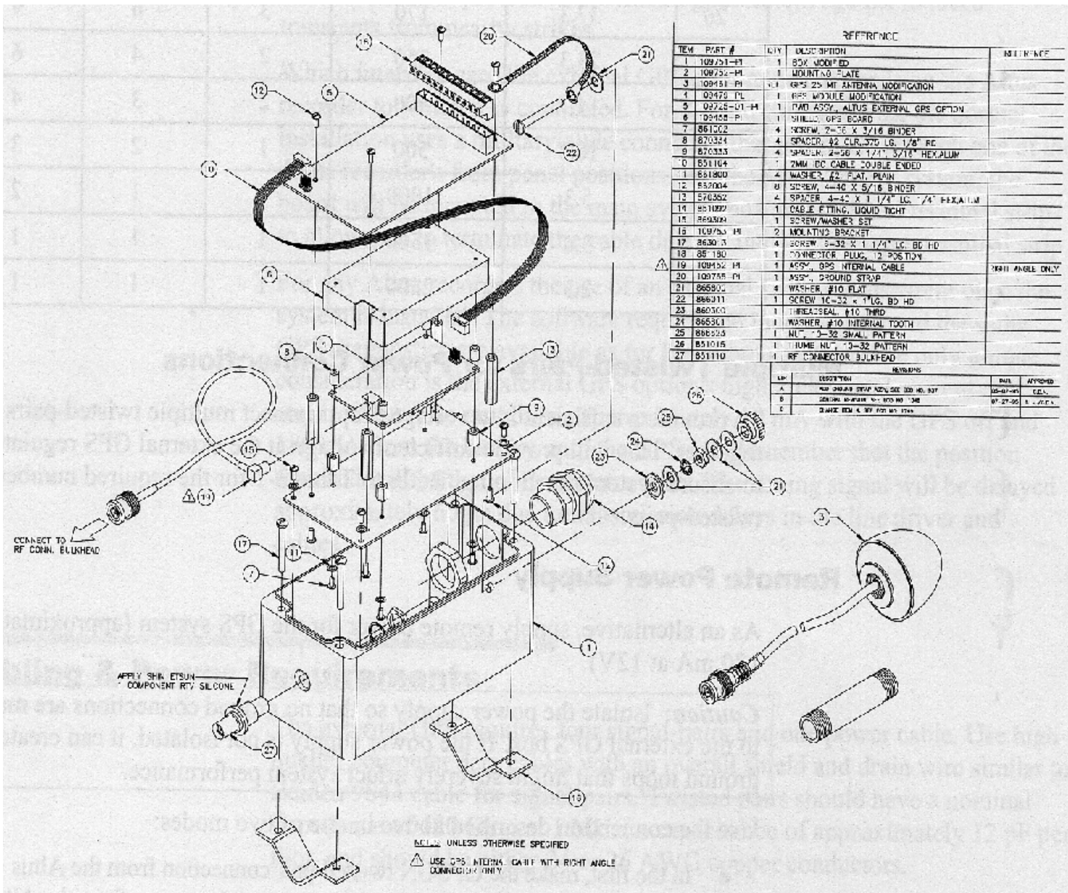


图 3-1 外部 GPS 接收器装配总成图

按如下步骤连接外部 GPS 接收器盒。

1 . 将电缆穿进电缆套管，其长度要有冗余（足够电缆进入接收器盒）。

2. 将终端线从其插槽中间向上穿出。将每根线剥去大约（7mm）的绝缘部分。如图（或表中）所示，将线插入终端线的正确位置。

3. 拧紧螺丝，固定电线。

4. 当所有的连接都完成后，将终端线插回插槽。

5. 将多余的线拉出接收器盒，调节电缆长度，做成一个方便于将来维修的

环，而后，加固电缆线，进行防水连接。

6. 在安装杆上固定接收器之前，如表 3-3 所示，将主板上的跳线都设置至正确位置。

注意：如果想提高分立式终端网络系统的传输质量，请不要通过 X6 安装 X3，可将终端网络直接装在终端的扁线上。

7. 在选定的位置固定 bullet 天线和外部 GPS 接收器盒。为保证接收信号效果满意，要确保 bullet 天线在室外的架设不被高大建筑物或树阻挡。外部 GPS 接收器盒与天线的距离，应保持至少 2 米，以免天线与接收器之间引起电的交互感应。

Bullet 天线有一个 3/4″ 的螺口, 能拧进带标准螺丝口的塑料管上，将天线电缆穿过此塑料管并连接到 GPS 接收器的天线插座上。

外部 GPS 接收器盒通过直径为 0.75″ —1.5″ 的精密孔用螺丝固定。或者，可以将 GPS 接收器盒装在有四个安装孔的用户装备上（如果用一铅笔线描出接收器盒的轮廓，则它们的大小可能是一个尺寸为 148mm×50mm 的矩形）。

8．将天线电缆上的 BNC 连接器与外部 GPS 接收器盒上的连接器相连。

9．将多余的天线电缆整齐地收好，拴在接收器盒旁。

注意：触电有生命危险。如果任何一端接地不正确的话，在电路和局部地面之间可能有潜在的致命电压，要使外部 GPS 与局部地面以及瞬时保护电路相互隔离开。所有装备的维修工作需具有专业资格的人员，还要确实查看当地的变压器。

10．用一根短编织带将接收器盒的接地螺栓与地线相连接。

该接地螺栓与电路板上的“ 保护地（PGP） ”相连，PGP 是气体避雷器的地线。在正常状态下连接在传输线上的气体避雷器与地线显示直流断路，而遭雷击时瞬间的脉冲电流则直达地面。

11．使用避雷装置（P/N 109457-PL）的用户应该参考本手册的第 2 章指导内容去连接保护器与内部 GPS 适时系统。而后就近接地。

表 3-2 外部 GPS 接收器盒的连接线

终端扁线位置	电线颜色代码	信 号 名 称	信 号 类 型	描 述
TS1-1	红色	+12V	电源	为远程 GPS 供电，+12V
TS1-2	黑色	GND	公共地	系统供电公共地
TS1-3	白/蓝	+GPSON	输入信号	GPS 加电信号（+）
TS1-4	蓝/白	-GPSON	输入信号	GPS 加电信号（-）
TS1-5	白/桔黄	+RXD	输入信号	从记录仪输入的 GPS 串行数据（+）
TS1-6	桔黄/白	-RXD	输入信号	从记录仪输入的 GPS 串行数据（-）
TS1-7	白/绿	+TXD	输出信号	将 GPS 的串行数据输出至记录仪（+）
TS1-8	绿/白	-TXD	输出信号	将 GPS 的串行数据输出至记录仪（-）

TS1-9	白/棕	+1HZ	输出信号	GPS 适时信号输出到记录仪（+）
TS1-10	棕/白	-1HZ	输出信号	GPS 适时信号输出到记录仪（-）
TS1-11	黑色	GND	公共地	系统供电公共地
TS1-12	屏蔽	PGP	（底板）	接地保护平面

12．盖好外部 GPS 接收器盒的盖子。

外部 GPS 的 12V 电压输出处有一个保险丝（F1）。如果烧坏，请更换为低于 1A 的保险丝（P/N 840524）。

表 3-3 跳线板

跳线	连接位置	注　释
X1	连接 1-2	控制默认的 GPSON 状态。连接 1-2 时，信号为“关”，并允许记录仪控制 GPS 的电源；而当远程遥控供电时，连接 2-3，将引起信号延迟。注意：X1 和 X2 的位置必须一致。
X2	连接 1-2	控制默认的 GPSON 状态。连接 1-2 时，信号为“关”，并允许记录仪控制 GPS 的电源；而当远程遥控供电时，连接 2-3，将使信号可被转换为“开”。注意：X1 和 X2 的位置必须一致。
X3	已安装	在 GPSON 线上控制 120 欧姆交流终端器。（如果由 12V 远程电源给记录仪持续供电时，取消 X3 的连接）。
X4	已安装	在 GPSRXD 线上控制 120 欧姆直流终端器。
X5	未安装	在 GPSTXD 线上控制 120 欧姆直流终端器。
X6	未安装	在 1Hz 线上控制 120 欧姆交流终端器。

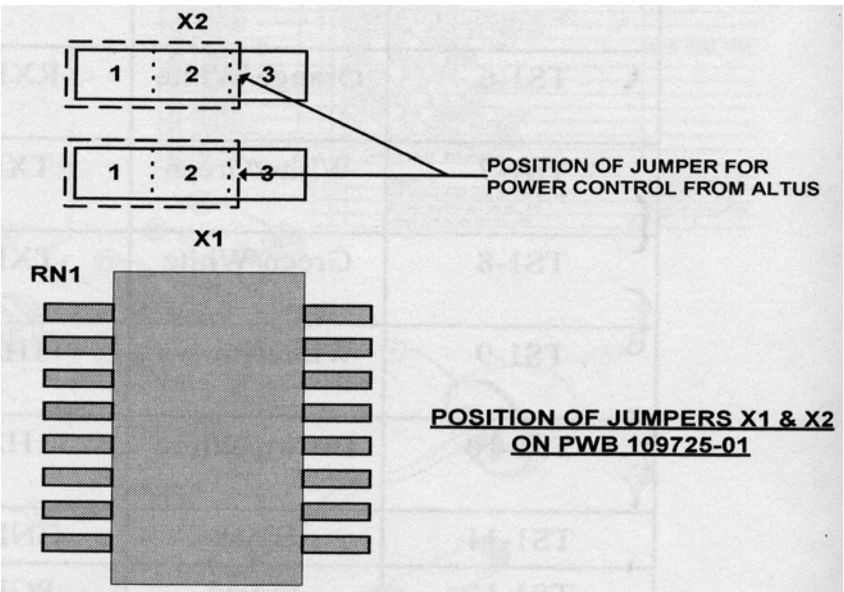


图 3-2 跳线 X1 和 X2 的位置

Altus 记录仪上用于遥控 GPS 电源开关 的跳线位置

在 PWB109725-01 上的 X1 和 X2 的跳线位置

连接 Altus 记录仪

参考表 1-1，检查在 Altus 记录仪上是否已安装 GPS 接座。

所有的 GPS 接口卡都提供 RS-485 接收器和驱动器。连接方法和装配位置不同，取决于设备是与终端扁线连接还是与军用连接器连接。

GPS 如何连接到 K2 或 Etna 记录仪

用于 K2（109470-PL）或 Etna 记录仪（109887-PL）的外部 GPS 接收机，由外部 GPS 接收器和带有绑定的连接器组成，此绑定连接器安装于记录仪右前方。它们在工厂中安装好了。若有更新会给出具体设备的有关说明。

外部 GPS 接收机应与 Kinemetrics 公司所提供的带有 GPS 选件（P/N 851185，Burndy 851-06EC14-12PN50）相匹配的连接器相连。若使用 Kinemetrics 电缆 700381，请参考表 3-4 中关于线型的介绍、推荐的导线颜色以及和连接器的终端焊接的位置等有关信息。

表 3-4 GPS 和 K2 或 Altus 记录仪的安装连接

连接器针号	电线色标	信号名称	信号类型	描述
J	红色	+12V	电源	为远程 GPS 供电，+12V
K	黑色	GND	公共地	系统供电的地线
A	白/蓝	+GPSON	输入信号	GPS 加电信号（+)
B	蓝/白	-GPSON	输入信号	GPS 加电信号（-)
G	白/桔黄	+RXD	输入信号	给记录仪输入的 GPS 串行数据（+)
H	桔黄/白	-RXD	输入信号	给记录仪输入的 GPS 串行数据（-)
E	白/绿	+TXD	输出信号	从 GPS 的串行数据输出至记录仪（+)
F	绿/白	-TXD	输出信号	从 GPS 的串行数据输出至记录仪（-)
C	白/棕	+1HZ	输出信号	从 GPS 输出的适时信号 (+)
D	棕/白	-1HZ	输出信号	从 GPS 输出的适时信号 (-)
L	黑色	GND	公共地	系统供电的地线
M	屏蔽线	PGP	板底	接地保护

按如下方法制作电缆插头：

1. 将双绞电缆线的外护套管剥去大约 17mm。
2. 将穗状屏蔽线双绕后，焊接到一根短电线上（短电线的长度应足够连至连接器的焊点 M 上）。
3. 用一个热缩管套在焊接线上。
4. 拉紧浮出的索环，拧紧并塞入外壳内。

5.　　将电线穿入灰色橡皮胶圈封闭的孔内，直至它从另一面伸　出为止。
6.　　将每根电线的端部剥去大约 4mm 的绝缘皮。
7.　　将电线逐个焊接到连接器上的焊点上。
8.　　将灰色橡皮密封放回，并拧下后面的外壳。
9.　　摆正拉紧浮出的索环，放在电缆套管上的正确位置，最后用两个夹片固定电缆并用螺丝固定。

电缆准备好后就可以与 K2 或 Altus 记录仪连接了。

按表 3-5 所示，设置板上跳线的正确位置。在通常情况下这些位置是厂家已配置好的，不需改动。

表 3-5 正确设置跳线位置

跳线	安 装	说　　明
X1	未安装	在接口板上不用。
X2	未安装	在接口板上不用。
X3	未安装	在 GPSON 线上控制 120 欧姆交流终端器 （若设备由远程 12V 电压连续供电，则取消它）。
X4	未安装	在 GPSRXD 线上控制 12 欧姆的直流终端器
X5	已安装	在 GPSTXD 线上控制 12 欧姆的直流终端器
X6	已安装	在 1HZ 线上控制 12 欧姆交流终端

注意：如果想提高分立式终端网络系统的传输质量，请不要通过 X6 安装 X3，可将终端网络直接装在终端的扁线上。

完成以上步骤后，外部 GPS 已安装完毕。用前面章节“ GPS 系统诊断程序 ”一章的有关 GPS 命令来更新系统。

外部 GPS 的接口板上有 12V 电压的保险丝（F1）。如果 F1 熔断，请用低于 1A 的保险丝（P/N 840524）替代。

GPS 与 Mt.Whitney 记录仪的连接

按如下方法将 GPS 电缆与 Mt.Whitney 记录仪正确连接。

1.将电缆通过开着的管道穿入 Mt.Whitney 记录仪箱内，并留有足够的长度。

2.向上拉动终端扁线。每根电线上剥去的 6mm 的绝缘部分，然后将电线插入终端扁线的正确位置，与记录仪的接口板相连，如表 3-6 所示。

3．拧紧螺丝，固定电线。

4．完成所有连接后，将终端扁线再插回到插槽内。

5．必要的话，调整电缆的长度，将多余的电缆盘成环状备用。

6．如表 3-7 所示，正确设置板上跳线的位置。

表 3-6 Mt.Whitney 终端扁线与接口板的连接

终端扁线位置	电线颜色代码	信　号名　称	信　号类　型	描　述
TS1-1	红色	+12V	电源	为远程 GPS 供电，12V
TS1-2	黑色	GND	公共地	系统供电的公共地
TS1-3	白/蓝	+GPSON	输入信号	给外部 GPS 加电信号（+）
TS1-4	蓝/白	-GPSON	输入信号	给外部 GPS 加电信号（-）
TS1-5	白/桔黄	+RXD	输入信号	给外部 GPS 的输入串行数据（+）
TS1-6	桔黄/白	-RXD	输入信号	给外部 GPS 的输入串行数据（-）
TS1-7	白/绿	+TXD	输出信号	从外部 GPS 输出串行数据（+）
TS1-8	绿/白	-TXD	输出信号	从外部 GPS 输出串行数据（-）
TS1-9	白/棕	+1HZ	输出信号	从外部 GPS 得到的 GPS 适时信号（+）
TS1-10	棕/白	-1HZ	输出信号	从外部 GPS 得到的 GPS 适时信号（-）
TS1-11	黑色	GND	公共地	系统供电的公共地
TS1-12	屏蔽	PGP	底板	保护接地

表 3-7 正确设置板上跳线位置

跳线	安　装	说　　明
X1	未安装	无用。
X2	未安装	无用。
X3	未安装	在 GPSON 线上控制 12 欧姆的交流终端器 （若设备由远程 12V 电压连续供电，则取消）。
X4	未安装	控制 GPSRXD 线上的 12 欧姆直流终端器
X5	已安装	控制 GPCTXD 线上的 12 欧姆直流终端器。
X6	已安装	控制 1Hz 线上 12 欧姆交流终端器。

注意：如果想提高分立式终端网络系统的传输质量，请不要通过 X6 安装 X3，可将终端网络直接安装于终端扁线上。

完成以上操作，GPS 已安装完毕。请用前面“ GPS 诊断程序 ”一章所讲的 GPS 命令来更新系统。

外部 GPS 的接口板上有一保险丝（为+12V 的电压输出），若保险丝熔断，可用低于 1A 的保险丝（P/N 840524）代之。

用户自定义终端器

以弱电供电标准配置 Altus 记录仪，用不同阻抗的电缆线就可以进行传输，或想用超过 1200m 最大传输长度的电缆，需在终端扁线上安装用户自选的交流或直流终端器。

直流终端设备也仅仅是一个与电缆的阻抗相匹配电阻器。RS-485 驱动器有标称为 120 欧姆的常规阻抗，所以在接收器这一端，应该调整到相应的阻抗与之匹配 。

为省电，可用交流终端来代替直流终端和电缆阻抗相匹配，这需要安装一个由电阻、电缆与电容组成的适配网络。确保电缆的分布电容值应恰好是 13pF/英尺（约 42 pF/m）。终端网络应安装于终端扁线上。拔去连接固定终端器的跳线 X3-X6。

注意：应用自定义终端网络时，在供电线上要有波形监视器和示波器监视。 这些作法也仅仅用在确实需要用一根长电缆进行传输的情况下，或确实需要使电的消耗量必须达到最小限度时。

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索 引

KINEMETRICS
Kinemetrics， 有限责任公司
222 Vista Avenue
Pasadena , California 91107
电话：626 .795 .2220
传真：626 .795 .0868
E-mail 地址：Sales@kmi.com

Kinemetrics SA
Le Tresi 3
1028 Preverenges
Switzerland
电话：21.8032829
传真：21.8032895
E-mail:neykmisa@iprolink.ch
网址：www.kinemetrics.com